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A SURVEY OF CIVILIAN DENTAL COMPUTER SYSTEMS(U) NAVAL
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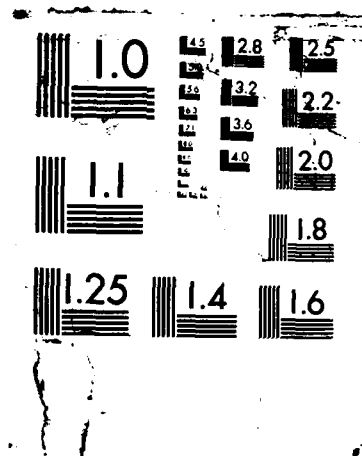
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A SURVEY OF CIVILIAN DENTAL COMPUTER SYSTEMS

M. C. DIEHL

Naval Medical Research and Development Command
Maryland

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A SURVEY OF CIVILIAN DENTAL COMPUTER SYSTEMS

M. C. DIEHL

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Naval Medical Command, National Capital Region
Bethesda, Maryland 20814-5044

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Approved and released by:

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A SURVEY OF CIVILIAN DENTAL COMPUTER SYSTEMS

M. C. Diehl

Purchase of commercially available materiel is one of the primary acquisition sources for the military. This source is widely believed to be a very cost-effective alternative to funded development of specially engineered items. Another advantage of this approach is more rapid procurement than in-house or contract development of equivalent items. Acquisition of a commercial dental computer system meeting military needs would likely provide major cost savings for the military dental services. **The objective of this study was to evaluate commercially available dental computer systems for potential use in military dentistry.** Only general features of these systems were compared to the requirements identified in the Tri-service Medical Information System functional description for the Dental Support System (DENTSS). There was no attempt to qualitatively compare individual systems against others, to determine which system was "best" for civilian practice, nor to identify which of these systems, if any, were most appropriate for the military dental environment. ←

BACKGROUND

Data automation has a short but significant history in the military dental services. Initially, this was limited to data processing support for dental public health research. This typically involved machine reading and computer processing of forms coded during clinical studies.^{1,2} In addition, innovative clinical applications, such as automated health history interviewing, were attempted during this time.³ Management applications in military dental clinics have evolved in a similar manner as those in the private sector. A primary requirement from the mid-1970's onward was to streamline the compilation and reporting of productivity data. Preventive dentistry applications, such as recall and unit dental profiles of military units have tended to be developed through individual initiative at the clinic and command level.

The history of automation in dental private practice may be segmented into four chronologic periods⁴. During the first period (1960-74), there were a small number of systems which offered limited general business management support. Of the few practices which employed computer support during this period, most used a service bureau. Service bureaus provided

general purpose business routines via batch processing and were not optimized for dental private practice. The use of courier or postal services for data transmission gave a very low response time, resulting in a tedious interface between the practice and the computer system. There were, however, some novel approaches. Kilpatrick described a punched card, batch operated book-keeping system using a telephone data link between a terminal in a dental office and a computer system in a local bank⁵.

The second period (1975-79) occurred coincident with the dawn of the microcomputer revolution. Although service bureaus were the prominent form of dental automation, the power of personal computing began to attract a small but enthusiastic following of dental practitioners. Those who developed home computer expertise often attempted to apply these skills to solve the problems of a burgeoning managerial workload in their offices. Several practitioners began looking at custom written software with functions designed for dental practice management in their specific business environment. Many ingenious applications resulted. Although some attempted a fully automated, "paperless" dental practice, the limitations of technology prevented successful implementation.

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Dental office management software was perfected in the third period (1980-83). This software usually consisted of wordprocessing, spreadsheet and database modules linked together to accomplish a variety of tasks unique to the dental office. As small systems technology and software capabilities improved, and greater numbers of practitioners and business managers turned to custom programming, hundreds of competing systems were marketed. Turnkey system and software prices began a steady decline. Most vendors suffered in the volatile marketplace with many ventures failing after delivering only a few turnkey systems or software packages. Although business applications dominated the marketplace, the orthodontic community continued to pioneer clinical automation through diagnosis, treatment planning and craniofacial-cephalometric analyses. Similar applications were undertaken by many maxillofacial surgeons. Also during this period, there was a growing interest in using artificial intelligence to augment the practitioner's diagnostic skills.

Current dental practice systems (Period IV - 1984-87) are moving toward an integrated business system with interrelated software modules. Generally these systems are implemented using leading supermicrocomputer or minicomputer technologies. Many systems designers have taken into account the information flow and personnel operations within the practice. The result is an enhanced man-machine interface via bar code, light pen, and similar technology for data entry, and optimal location of workstations within the practice. Business management functions have reached an evolutionary plateau. True multitasking and multiprocessing functions are limited to minicomputer and advanced microcomputer hardware, and UNIX-like operating systems. Clinical dental computing remains in an embryonic state with substantial research still being required in computer assisted diagnosis and automated clinical records.

MATERIALS AND METHODS

Three needs areas for Navy dental services were determined in previous study:

- (1) management information, for the services reporting and decision making processes in all echelons of military dental operations,⁶⁻⁹
- (2) information for public health and clinical research studies, services planning and quality assurance, as

determined in previous work,^{8,9} and

- (3) postmortem dental identification.¹⁰⁻¹²

Specifics were determined from the Dental Support System (DENTSS) Functional Description, Dental Management Information System (DENMIS) documentation and discussions with Navy Medical Command (MEDCOM), DENMIS and clinic managerial personnel, and professional staff. These sources, in particular the DENTSS Functional Description, summarize the features of the desired military dental system center around improving the services' approach to:

- (1) patient registration, identification, and appointing
- (2) management of patient dental records
- (3) personnel and resource management
- (4) dental clinic and laboratory management
- (5) quality assurance and management
- (6) system optimization with non-labor intensive features, automated data entry and streamlined report preparation and utilization.

General features found in private practice computer systems were extracted from various dental systems references.¹³⁻²⁰ These features were correlated to current dental systems by a market survey, using sources such as advertisements in trade and professional journals. Detailed descriptive data on commercial dental computer systems from Periods III and IV, as previously described, were then collected. Sources for these descriptive data were:

- (1) in-house use of commercial systems or demonstration software packages, and in-house demonstration of systems by vendor representatives,
- (2) hands-on evaluation of commercial systems on display at professional meetings,
- (3) review and comparison of vendor marketing materials, discussions, demonstrations and presentations from technical and sales personnel, and video tape marketing presentations,
- (4) review of system documentation packages including report printouts and illustrations of video display screens,
- (5) professional and trade publication reviews,

(6) observation of system operation in the private practice setting, with user (practitioner and staff) discussions, and

(7) discussions with dental system developers, technical and sales personnel and prominent dental system consultants.

Additional descriptive data for Period III dental systems were extracted from marketing materials and compiled from professional and trade periodicals and reports.¹³⁻²⁰ The dental systems used in this study are listed in Table I. A product citation denotes only that material was available and used. Citation does not imply preference to nor superiority over similar products which were not included in this study.

Specific features for individual systems were collated and the resultant generalized data were compared for relevance to the mission of military dental services. Criteria for evaluation were:

- (1) functional equivalence, as satisfying a specific need of a military dental computer system without modification,
- (2) a basis for adaptation where the system features could be modified to provide a function required of a military dental system,
- (3) non-relevance to the military dental service, i.e., where an information management feature in the commercial system has no corresponding requirement in military dentistry, and
- (4) an attribute or possible future need of a military dental system which may be satisfied by existing features of commercial systems.

The initial group of evaluation systems was comprised of business management systems and applications software. Practice management systems, particularly those having a substantial clinical component, were subsequently evaluated.

RESULTS

Data processing support provided to dental practices may be grouped into three categories. *Applications* are limited in scope to one or two practice manage-

ment tasks such as insurance billing or recall management. *Business management systems* contain numerous applications (typically financial modules) which are selected from a system executive and employ a limited number of databases. *Practice management systems* incorporate a patient records component of varying sophistication and other enhancements, eg. productivity analysis, into the business management system. Despite advertising claims, there are no comprehensive, fully integrated dental practice systems currently marketed.

Civilian dental system features

The general features of civilian dental systems which were identified and correlated to military dental system requirements are discussed below:

- (1) Recall and appointment. These features are commonly found in civilian dental applications, business and practice management systems. Although the civilian system methodology is not directly suited to military dental practice, it can be readily modified to adequately serve in most Navy dental clinics. Fields such as military unit, deployment address, etc. would need to be added to the civilian system data set.
- (2) Billing. There is no current need for a computer system to have a patient, insurance or public aid billing capability for dental services in Navy clinics. This feature is, however, commonly found in many applications and forms the core of most business and practice management systems. There is, therefore, no equivalence between Navy dental system requirements and this civilian dental system capability.
- (3) Accounts receivable. Like the billing modules, there is no direct comparison between Naval and civilian requirements. Therefore this feature has no equivalent function in a military dental system.
- (4) Accounts payable. Although there may be varying needs for this capability in Naval dental clinic financial management, there is no direct equivalence between this feature in civilian systems and the operating requirements of the military clinic. Typically, Naval clinics have perfected techniques, often using computer support, to meet needs such as open purchases, contracts and civilian payroll. A module in a civilian dental business or practice system would need significant modification for equivalent performance in this environment.

(5) Productivity management. Such functions generally give the practitioner or office manager an ability to assess the practice in terms of cost and revenue centers. The astute practitioner may thus alter the mix of services to increase high margin activity and minimize low margin or loss procedures. A few systems provide a minimal public health analysis to enable the practitioner to adjust the services mix to the needs of a long term, fixed patient population. There is no exact equivalent to these functions in military dentistry. Similar techniques are employed by clinic managers and administrators to optimize service to their patient populations and provide the best care available to individual patients. The productivity analysis modules of civilian systems would need major modifications to perform adequately in the military clinical environment.

(6) Personnel Management. This administrative function is used to maintain employee records, prepare payroll, and perform related tasks. Some modules prepare employee paychecks. Practices with a low level of computing (i.e., applications oriented) may provide this function via a general purpose personnel management program. This feature is often included in larger systems intended to support large practices with complex personnel management functions. A considerable amount of adaptation would be required to use this feature in the military clinics.

(7) Supplies. This capability is found in only a few practice management systems. The modules are essentially inventory managers tailored to dental practice consumables and business supplies. With significant modification, particularly relating to the Federal stock system and open purchase operations, this feature could serve in the military clinic.

(8) Correspondence. Dental practices which have a low level of computer utilization typically employ commercially available word processing software for this function. Similar general purpose word processing or text processing features are built into many business and practice management systems. All would be useable without modification in the military dental environment.

(9) Clinical documentation. This capability is found in a only few comprehensive practice management systems. Generally, three features are found: a medical history, medical precautions and some form of clinical record. Medical history and precautions features streamline this aspect of patient management and docu-

ment practitioner awareness of items of medical importance. The clinical record is generally limited to cursory notes sufficient to complete select fields found on insurance billing forms (tooth number, surfaces, etc.). These modules would require extensive modification to document the clinical record in a military dental system. However, such modules are adequate without modification as a data source for narrow scope applications such as computer assisted dental identification programs or epidemiology data acquisition for clinical research.

(10) Quality assurance. There is only a very limited quality assurance capability in minicomputer based systems for the larger group practices and those systems supporting organizational dentistry (hospital, storefront, etc.). No civilian system has features which are equivalent to nor which can be easily modified to meet the requirements of the military quality assurance program.

Table II. summarizes the features of civilian dental software and their relevance to the military environment.

Military dental system requirements

The specific functional requirements and attributes of a military dental system have been described as a conceptual model in the DENTSS Functional Description.²¹ This model translates to system functions and includes the following features:

(1) patient identification — all functions necessary to enter, verify and maintain patient data, search for and extract selected data based on name, identification number, etc., with partial match capability and a rapid data entry method.

(2) staff identification — those functions needed to enter, query and report staff name, assigned treatment facility, specialty designation, and department assignment.

(3) patient registration — entry and maintenance of registration data with a demographic data subset, comment/remarks section, VIP data suppression, automatic DEERS check with reporting features, and the capability to handle walk-in and emergency encounters and telephone consultations.

(4) staff management — creates and maintains personnel management data including such features as training, credentialing, privileges, and demographics, with

query/report capabilities and an ability to forward data on personnel reassignment. Staff personnel scheduling and assignment are important features of this function.

(5) *physical resources management*—including logistical activities such as management of plant property and equipment, high value materials, and supplies management

(6) *appointment and scheduling management*—including selection, assignment, modification, query and report features, ability to produce listings such as day-sheets and schedules for individuals and facilities, message and scratch-pad capabilities, ability to maintain waiting lists and stand-by patient listings, and perform recall management tasks.

(7) *patient dental health information management*—provides direct provider-patient encounter support including entry and maintenance of clinical records data, records transfer capability, records report preparation, forensic identification data management and preparation of productivity reports.

(8) *dental laboratory data management*—prescription transmission, case critiquing, turnaround documentation, query and reporting of casework and productivity management.

(9) *quality assurance and risk management*—providing an interactive data management capability to assist the authorized quality assurance personnel to access and use data for problem identification, documentation, solution and reporting.

(10) *operational report preparation*—production of periodic and on-demand reports regarding all facets of system function, clinic management and administration.

(11) *system management*—the ability to efficiently govern all aspects of system operation including maintenance of system functions, physical security, data storage and security, and the ability to perform text processing and prepare ad-hoc reports.

Table III. summarizes the requirements of a military dental system, per the DENTSS Functional Description, and if and how these requirements may be met by features found in the civilian dental systems.

As noted from Tables II and III, the emphasis of

data processing support for the private practice is financial management and patient recall. Many features required of a military dental system, eg. quality assurance, clinical information, resources management, etc., have no equivalent functions in a civilian system. Of those features in civilian systems which are comparable to the features envisioned of a military system, most would require extensive modification. Hourly reprogramming costs range from \$50 to \$100, and a typical, experienced programmer is capable of producing 10 to 12 lines of error-free, tested code per hour. With substantial modifications required, the cost of adapting an existing civilian system would be a major expense. This cost must be considered along with software and/or site licensing base costs and compared to the development cost for a military-specific dental system.

DISCUSSION

Two basic forms of dental computer systems exist: "turnkey" systems and software systems. Turnkey systems include all components necessary to operate a dental practice information system—computer and peripheral equipment, software and documentation. These systems are intended for practitioners who desire to use a computer with a minimum of understanding or interaction on the component level. Software systems generally include only the practice management program, and varying amounts of operation documentation. Software systems are intended for practices which have appropriate computer hardware readily available. There is a broad range of operation, training and maintenance support available (from minimal documentation to comprehensive manuals, telephone hotline and on-site support).

Developers of turnkey systems expend considerable effort configuring the components of their systems: the hardware subsystem, the software subsystem, etc. Much of the cost of the turnkey system is manifest in the hardware configuration and its integration with the software. Developers may act as original equipment manufacturers (OEM's) in which they obtain useable hardware at minimal cost and substantially mark up a specially configured subsystem. These systems may employ uncommon computer architectures and species. Many use various brands of "clone" and generic computers, some of which are not usually associated with health care systems. There are tradeoffs for the "hands-off" utility demanded by many professionals who purchase these systems. Equipment maintenance in many cases

can be difficult at best. Prices are generally very high and the numbers of any given system are often relatively low.

In contrast, developers of practice management software systems expect the practitioner, business manager or consultant to actively participate with the vendor in implementing the system. The software system corresponds to the software subsystem of the turnkey systems. Software system developers and vendors are more numerous and are usually smaller organizations than those preparing turnkey systems. The development process is far more easily accomplished, consumes fewer resources and requires less expertise than developing a complete turnkey system. These characteristics result in lower development costs and make software systems substantially less expensive than the turnkey systems. Vendors usually develop software for the most commonly found microcomputer system to maximize marketability, hardware availability, maintenance and user familiarity. This means that in Period II, most dental software was written for Apple II hardware, and in Periods III and IV nearly all dental software was prepared for the IBM PC/XT/AT and clones.

The majority of current dental practice systems operate on hardware employing the 8088/80286 processors and the IBM PC-type bus. Various alternative minicomputer and microcomputer systems occupy relatively small and specific market segments. The prevalent operating system is MS-DOS with Unix/Xenix often found in the larger, multiuser dental practice systems. Although other operating systems, eg. PICK, have gained increasing acceptance in the medical systems arena, such systems remain uncommon in dental systems. High level languages are preferred, with some systems written using application generators. Owing to the fundamental limitations of Assembly Language programming, there is little low level programming of dental systems beyond small modules such as device drivers. The prevalent language for dental systems is compiled BASIC. Some software is available in COBOL, C Language and particularly in various database management languages and report generators. High caliber software is becoming more common as developers gain expertise with fourth generation languages and the UNIX-like operating systems.

Four origins of commercial dental computer systems and software were found. Many systems and applications are developed by private practitioners to satisfy their specific needs and are subsequently mar-

keted. Other systems may be developed by a non-dental health systems vendor (eg., medical, legal or other professional computer system) and subsequently adapted for dental practice management. General management systems developed by business specialists (eg., accountants) may be adapted to the dental practice setting. Finally there are systems intentionally developed for the dental systems market by a venture team consisting of data processing, business management and dental professionals. Practitioner developed and unmarketed applications are a hidden and unquantifiable component of the dental systems universe. Many of these systems and applications contain highly unique and unusual features which may not be generally accepted by other practitioners. With a limited market potential, some of these programs find their way into the public domain.

Most systems remain exclusively business management oriented. Between 5 and 10% of the recently released dental practice systems include some form of clinical component. Many of these were developed to satisfy the need of general practitioners and specialists for better periodontal case documentation. Several systems have enhanced this capability to encompass all clinical disciplines. During the mid 1970's, some practitioners developed automated clinical records modules on their own practice systems. These concepts were far ahead of the technologic capabilities of Period II dental systems. Numerous catastrophic failures had disastrous consequences for most of these innovators, and their experiences have jaded the views of the profession as a whole toward automated clinical records. The expectations of recent graduates and the increasing need to better document clinical cases are creating a demand for this feature. Thus market pressure will drive future dental systems to include a significant clinical computing capability.

The technologies employed by individual systems bear markedly on their utility. Nearly all of the systems reviewed rely upon the keyboard for data entry. In this mode, the clinician completes a source document (eg., charge ticket, walk-out statement, superbill, etc.) which is subsequently entered into the system by a clerical employee at the keyboard. Some of the civilian systems have optional alternatives to keyboard data entry: light pens, bar code readers, optically read charge tickets, and voice recognition methods have been marketed as a means to streamline a cumbersome man-machine interface. Input/output technologies are gener-

ally independent of the unique requirements found in military or civilian practice settings. In general, those systems employing pointing technologies, light pen and touch screen, have a higher transaction throughput for discrete data items. Voice recognition data entry has been marketed and appears to perform adequately within its significant technological limitations. Bar code data entry has been incorporated in several systems with considerable success and has notable proponents among dental computing and practice management consultants.

User difficulties with computer system operations can be expected to be the same for military and civilian users. The majority of problems that private practitioners find with dental systems can be grouped into four areas. Foremost, practitioners tend to expect greater performance from the system than was designed, and are disappointed when the system fails to deliver. Another problem which has always haunted private practice systems is imperfect systems and software. Ongoing vendor support of the user is a critical element in successful operation. Many practitioners find the volatility of the dental systems marketplace to negatively impact on support: each year from 20 to 40% of the dental systems vendors fail in the marketplace.²⁰ System problems from soft errors are due to transient events like power fluctuations and even cosmic rays. Soft errors are infrequent but often produce catastrophic failures such as system hangs, data destruction, etc. Without extensive familiarity with the hardware and software interaction, such failures are usually unrecoverable. Finally, users often fail to provide an appropriate computer environment. Practitioners have been observed to store and manipulate unjacketed floppy disks adjacent to plaster model trimmers, thus subjecting the disk to both dust and stray magnetism. In an effort to reduce expenses, users may fail to provide a conditioned electric power supply and uninterruptable power sources, and may delay or omit frequent data back-up. Catastrophic failure in such a hostile environment is inevitable.

CONCLUSIONS

None of the civilian systems have management modules appropriate for military use in an "as is" basis nor could they be used without cost prohibitive modification. As noted from Tables II and III, the emphasis of

data processing support for the private practice is financial management and patient recall. Many features required of a military dental system, eg. quality assurance, clinical information, resources management, etc., have no equivalent functions in civilian systems. Modifications to an existing civilian system would require approximately the same work as new programming, and would therefore be nearly as costly. Where a new program could be tailored to meet specific needs, modification of the civilian system cannot be relied upon to produce as capable a product.

Only a few dental systems have a clinical records component which could be adapted to meet the DENTSS requirement. All would need modification to manage records receipt and transfer, temporary and replacement records, and to function within the military environment involving temporary duty assignments and a high degree of personnel mobility. For a comprehensive, integrated system as envisioned in DENTSS, such modifications would be cost prohibitive compared to new software development.

A few practice management systems offer a report generator feature. This feature enables the practitioner to prepare a custom clinical records module. The records modules of those systems are quite acceptable "as is", or can be inexpensively tailored for specific tasks. Some of these systems can produce an ASCII format output from this clinical module: this output can be readily used as a data source for clinical research and postmortem dental identification programs. Such stand-alone tasks are typical of the few instances where the civilian dental system may be useable in the military environment without modification.

In contrast to the application-specific records system for postmortem dental identification, substantial adaptation of clinical modules in the commercial systems would be required for use in a comprehensive system for the military environment. It would be more cost effective to develop the clinical components specifically for comprehensive systems such as DENMIS and DENTSS, rather than attempt to modify existing commercial systems: the amount of design and coding work would be equivalent and the quality of the product would better meet military requirements.

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ADOSI-TRIAD
Alpha Healthcare
AlphaDent Comprehensive
 Management Systems
APM-Sterngold Computer Assisted
 Attachment Case Design
APT Dental Billing System
Artex Compugnath
Articulate Publications -
 Dentalis System VI
Artificial Intelligence - PAS-3+
Automated Management Services -
 Dental Billing System
BRS Dental Office
 Management System
Burger Dental Billing System
Business Data Corporation -
 AVATAR Dental Series
Byte Doctor Software -
 Dental Office Manager 5.1
C-Care - C-Dental
CalData Systems - DentalWare
Calyx DDX
Champagne Associates -
 Total Recall
Charles Mann Associates -
 Dental Office Management
Cobb Dental Business System
Colwell - Denti-log
Computer Age Software -
 Computer Age Dentist
D.D.S. Inc. - Dental
 Management Software
Data Management -
 Dental Management+

Data Team DDS
Data*Team Bushwacker 1.1
Dataday - Floss Dental
 Computer System
Datatrak Dental Data System
DB Consultants - Patient
 Accounting System (PAS/PC)
Dental Diagnostic Systems DDS
Dental Management Plus
Dental Office Computer
 Systems - DOCS
Dental Plan — Easy Dental
 Software System
Dental Systems Ltd. -
 Differential Diagnostic
 Assistant - Soft Tissue
Digital Equipment Corporation -
 Dental Practice Management
 System
DLC - Microflex/DDS
Doctors Data Management
 Corporation - DDMC
Driver-Harris - Suzy Dental
Easy-to-Use Software - DENPAC
Flash Software -
 Contract Payment Program
Florida Probe
Global Software - Dentacomp
GLR Systems - Unident
Hayden - Dentistaid
HealthCare Communications -
 DentalMac
Healthco - Dental Office
 Management System

Table I. DENTAL COMPUTER SYSTEMS
AND SOFTWARE REVIEWED

**HPMS - Dental Office
Management System**
**Human Touch Software -
PatientBase Dental Office
Management System**
**International Computer Systems
- Dental Management System**
**K-Comp - Dental Management
Computer System**
Kamp Mixed Dentition Analysis
**Key Management - Dental Office
Receivables Insurance
Scheduling**
**Laboratory Systems Group -
Lab Manager (I and II)**
Lalor Building Block System
**MBC - Legend Graphic
Dental Management**
Medivation - Dental Coupler
Megalo System
**Micro/Sys 80 - Dental/Medical
Accounts Receivable and
Billing System**
Microcomp - DDSsystem
**Microcomputer Management -
Dentistaid**
Mitex - MCS/70
**Monument Computer Service
- Dental Accountant
- Dental Secretary PCE**
**Moore Business Systems (Vertex)
- Dental Practice Manager**
Moore - OM&S Manager
MPI - Practice Manager
Myotronics K-6 Diagnostic System
Optisoft - Professional Computer

System
OR-D Dental System
Periogram
Praxis - Praxident
**Premier-Floryan - Computer
Management System**
**Professional Software Solutions -
Softdent**
**Razorbyte Software - Dental
Office Management Software**
**Rocky Mountain Orthodontics
- CADIAS/RDE**
**Safeguard Dental Practice
Systems**
**Salem Information Systems -
Dentacomp**
**Shenandoah Microcomputer Services
- Patient Service System**
Software Hows - Micro-dent
Software Technologies - DENTECH
**Sound Software Systems -
Receptionist's Aid**
SRC ADIS/ADHQ
Stellar Orthodontics
Sycom Micro-System Data-Plan
Sycom Service Bureau Data-Plan
Three Star Dental Systems
**Univair Systems - Dental
Office Management System**
Whelan Associates - DentaLab
Windham Dental Office System
**Wisner-Martin - Dental Practice
Management System**
YDC - Dental Office Insurance Manager

*The listing of a computer system, software system or application in this
table does not imply endorsement of the product nor preference to
other dental computer products on the market.*

SYSTEM FUNCTIONS	APPLICATION SOFTWARE	BUSINESS MANAGEMENT SYSTEMS	PRACTICE MANAGEMENT SYSTEMS	MILITARY RELEVANCE
RECALL AND APPOINTMENT	MANY	SOME	MOST	MODERATE MODIFICATION REQUIRED
BILLING	MANY	MOST	ALL	NO RELEVANCE
ACCOUNTS RECEIVABLE	MANY	MOST	ALL	NO RELEVANCE
ACCOUNTS PAYABLE	FEW	SOME	MANY	POSSIBLE FUTURE NEED WITH MODIFI- CATION
PRODUCTIVITY MGMT	FEW	SOME	MOST	MODERATE MODIFICATION REQUIRED
PERSONNEL MANAGEMENT	NONE	FEW	MANY	SUBSTANTIAL MODIFICATION REQUIRED
SUPPLY INVENTORY & ORDERING	FEW	FEW	SOME	SUBSTANTIAL MODIFICATION REQUIRED
CORRESPON- DENCE	WORD PROCESSING SOFTWARE	MANY	MOST	EQUIVALENT
CLINICAL RECORDS & APPLICATIONS	FEW	NONE	FEW	MODERATE MODIFICATION REQUIRED
QUALITY ASSURANCE	NONE	NONE	FEW	SUBSTANTIAL MODIFICATION REQUIRED

TABLE II. FEATURES OF CIVILIAN DENTAL COMPUTER SYSTEMS

DENTSS FEATURES	CAPABILITY FOUND IN CIVILIAN DENTAL SYSTEMS	MODIFICA- TION OR NEW CODING REQUIRED
PATIENT IDENTIFICATION WITH RAPID DATA ENTRY	KEYBOARD DATA ENTRY IN MOST SYSTEMS	MODERATE
STAFF IDENTIFICATION	NEEDED ONLY IN MULTI- PRACTITIONER SYSTEMS	SUBSTANTIAL
PATIENT REGISTRATION WITH <i>DEERS</i> CHECK-REPORTING	GENERALLY FOUND BUT NO <i>DEERS</i> CHECK	SUBSTANTIAL
STAFF PERSONNEL MANAGEMENT, CREDENTIALLING AND SCHEDULING	TYPICAL FEATURE WITH CREDENTIALS MODLE ONLY IN LARGE SYSTEMS	MODERATE
PHYSICAL RESOURCES MANAGEMENT	NOT FOUND IN MOST SYSTEMS	SUBSTANTIAL
PATIENT APPOINTMENT AND SCHEDULING	STANDARD IN PRACTICE MANAGEMENT SYSTEMS	MODERATE
DENTAL HEALTH INFORMATION, CLINICAL RECORDS, TRANSFER AND FORENSIC DATA	NOT FOUND IN MOST DENTAL SYSTEMS	SUBSTANTIAL
DENTAL LABORATORY MGMT	ONLY IN DENTAL LABORA- TORY MGMT SYSTEMS	MODERATE
QUALITY ASSURANCE AND RISK MANAGEMENT	NOT A TYPICAL FEATURE: SOME DO VIA REPORT GENERATOR	SUBSTANTIAL
OPERATIONAL REPORT PREPARATION	PRACTICE MANAGEMENT REPORTS COMMON IN LARGER SYSTEMS	SUBSTANTIAL
SYSTEM MANAGEMENT WITH AD HOC REPORTS	GOOD CAPABILITY IN LARGER SYSTEMS, VARIABLE IN REST	MODERATE

**TABLE III. COMPARISON OF *DENTSS* REQUIREMENTS VERSUS
CIVILIAN DENTAL COMPUTER SYSTEM CAPABILITIES**

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military dental computer system. Military requirements such as maintenance of dental health information and quality assurance capabilities are not typically found in civilian systems.

Although it appears possible to adapt civilian dental computer systems to meet military requirements, this would be a protracted and costly software modification process. Existing civilian systems are, therefore, not good candidates for a comprehensive military dental system such as DENTSS. However, several of these systems contain clinical documentation modules which would be useable without modification for self-standing, small applications such as data acquisition for clinical research studies and forensic dental identification programs.

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